Atmospheric and Ionospheric Research Using a Small Expendable Deployed Satellite

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MSFC is defining potential future tether missions; one of which is the proposed Atmospheric and Ionispheric Research Using a Small Expendable Deployed Satellite Mission. This mission, which is based on NASA's successful and proven Small Expendable Deployer System program, will collect atmospheric information in the altitude range of 260 to 125 kilometers via a tethered satellite lowered from the space shuttle orbiter. This region of near-Earth space is inaccessible by high-altitude balloons, aircraft, or orbiting spacecraft and is often called the "ignorosphere." The scientific and engineering information to be gained from the mission is essential to understanding and modeling atmospheric and ionospheric phenomena, including satellite drag, the effect of relativistic electrons on upper-atmospheric chemistry and ozone depletion, the energy deposition from magnetospheric currents and particle precipitation, and the spatial and temporal gradients in ionospheric properties.

MSFC is working in partnership with The Michigan Technic Corporation, Holland, Michigan, in mission definition and planning. In addition to the ground-breaking science to be accomplished by the mission itself, the innovative consortium being assembled for the effort exemplifies one aspect of the new philosophy under which NASA is seeking to do business and conduct scientific research. Michigan Technic is working to secure nongovernmental funding of the instruments, probe, tether, and tether deployer. The consortium would then provide this payload to NASA in exchange for launch aboard the space shuttle orbiter. All science data gathered during the mission will be treated in accordance with standard NASA practices. While no commitments for launch have yet been made, both MSFC and its potential partner are studying the technical and programmatic aspects of the mission and working toward such an arrangement.

The payload consists of three primary components—the probe, the tether deployer, and the tether. The payload is designed to be integrated with either the Hitchhiker-C, or the multipurpose experiment support structure pallet, and fit within the envelope of the orbiter. The probe capsule will contain scientific instruments, while the boom/wing assembly will provide separation between the global positioning system receiver antennas, supplemental instrument mountings, aerodynamic stiffness, as well as assist in control system desaturation in the yaw motion for flight below 185 kilometers.

The instrument suite includes an anemometer to measure pressure, heat flux sensors to measure heat transfer to the surface of the probe, a three-axis accelerometer, a mass spectrometer for characterizing atmospheric constituents, Langmuir probes to determine plasma density and temperature, a medium-energy particle detector, and a high-energy electron detector.

The mission will not only advance our understanding of this little-studied region of the Earth's upper atmosphere and demonstrate the use of advanced tether technology for science applications, but it may also serve as a pathfinder for a new type of government and industry partnership for performing high-value science at a lower cost.

Santangelo, A.D. April 1995. Atmospheric and Ionispheric Research Using a Small Expendable Deployed Satellite (AIRSEDS–II): A Tethered Satellite System (TSS–2) Precursor Mission to Test and Demonstrate Tethered Systems in the Earth's Upper Atmosphere. Proceedings of the Fourth International Conference on Tethers in Space, Smithsonian Institution, Washington, D.C.

Sponsor: Office of Space Flight

Industry Involvement: The Michigan Technic Corporation, Holland, Michigan

University Involvement: University of Texas at Dallas, University of New Hampshire